











MEMOIRS  
OF THE  
GEOLOGICAL SURVEY OF INDIA.

*Palæontologia Indica*

BEING

FIGURES AND DESCRIPTIONS OF THE ORGANIC REMAINS PROCURED DURING  
THE PROGRESS OF THE GEOLOGICAL SURVEY OF INDIA.

PUBLISHED BY ORDER OF HIS EXCELLENCY THE GOVERNOR GENERAL OF INDIA IN COUNCIL.

Ser. X.

INDIAN TERTIARY AND POST-TERTIARY VERTEBRATA.

Vol. II.

Part 5. SIWALIK SELENODONT SUINA, etc.

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Geological Survey of India.

WITH 3 PLATES—Nos. XXIII to XXV.

CALCUTTA:

SOLD AT THE

GEOLOGICAL SURVEY OFFICE, AND BY ALL BOOKSELLERS

LONDON TRUBNER & CO

MDCCCLXXXIII 1883

PRINTED BY GIBBS AND BANTFORTH, AT THE "HERALD ADVERTISER" OFFICE, MARKET PLACE, ST. ALBANS, HERTS



## PREFACE.

THE present fasciculus contains a notice of all the forms of selenodont Suina yet known from the Siwaliks and Mauchhars. Many of these forms are new, although the remains are extremely imperfect and scanty. Their description has involved the creation of certain new genera on very slight materials.

As a personal matter I may state that, although my retirement from the Geological Survey of India is imminent, yet arrangements are being made by which it is hoped that the present work may be continued. It is possible that this fasciculus may appear before the preceding one--on the *Canclopardalidae*--which is being printed in India. The succeeding fasciculus, which it is hoped will appear during the present year, will be devoted to the Carnivora.

RICHARD LYDEKKER.

THE LODGE,

HARPENDEN,

HERTFORDSHIRE.—*February*, 1883





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# INDIAN TERTIARY AND POST-TERTIARY VERTEBRATA.

## SIWALIK SELENODONT SUINA, ETC.

By R. LYDEKKER, B.A., F.Z.S.,  
GEOLOGICAL SURVEY OF INDIA.

(WITH PLATES XXIII. to XXV.)

ORDER : UNGULATA ; DIVISION : ARTIODACTYLA ;

SECTION : SUINA SELENODONTIA.

*Introductory.*—The extensive and important group of pig-like Artiodactyle Ungulata, commonly classed together under the head of Suina, may conveniently be divided into two subordinate groups, distinguished from each other by the structure of their molar teeth. The first of these groups may be termed the Bunodontia,<sup>1</sup> and is characterised by having the cusps, or columns, on the grinding surfaces of the upper molar teeth arranged either in an irregular manner, as in the common pig, or with a more or less distinct tendency to the production of larger columns at the four angles of the crown as in *Tetraconodon*<sup>2</sup>: this group comprehends the hippopotamus, and all living pig-like animals, as well as the extinct *Hypotherium*, *Entelodon* (*Ellotherium*), and their allies. The second group, forming the main subject of the present memoir, may be termed the Suina Selenodontia,<sup>3</sup> and is characterised by the upper molars having their inner pair of cusps, or columns, of a more or less distinctly crescent shape. This second group is now totally extinct, and is represented by *Chæropotamus*, *Hypopotamus*, *Oreodon*, and a host of kindred forms. As is nearly always the case in a large group of animals, there is always a difficulty in referring all the forms to their respective sub-division, and this is exemplified in genera like *Chæropotamus*, and some species of *Anthracotherium*, which, though belonging to the selenodont group, yet afford an easy transition from its most typical members, like *Oreodon*, to some of the more specialized of the bunodont group, like *Tetraconodon*.

<sup>1</sup> From *bounos*, a hillock, and *odous*, a tooth.

<sup>2</sup> *Ibid. sup.*, Vol. I., pl. X.

<sup>3</sup> From *seleno*, the moon, and *odous*.

In the present memoir numerous remains, belonging to various hitherto undescribed forms of the selenodont group, are figured and described, while, in addition brief notices are given of such members of the group as have been previously described from the tertiaries of India. It will be found that by far the greater number of these specimens have been obtained, by the exertions of Messrs. W. T. Blanford and F. Fedden, of the Geological Survey of India, from the lower Manchhar (Siwalik) rocks of Sind and the districts to the northward.

It will further be observed that the genera are identical with, or closely allied to those of the European oligocene and miocene; the later genera characteristic of the sub-Himalayan deposits being in the main absent. These differences indicate that the mammalian fauna of the lower Manchhars of Sind belongs to a lower horizon than that of the sub-Himalayan Siwaliks. According to the latest researches 'it seems probable that the fauna of the lower Manchhars should be relegated 'to the early pliocene time,' while that of the sub-Himalayan Siwaliks, which are on the same horizon as the upper Manchhars of Sind, belongs to a later period of the same epoch; there being a probability of the higher beds of the former reaching up into the pleistocene. In the present and succeeding memoirs the age of the lower Manchhars will be alluded to as 'earlier pliocene,' and the sub-Himalayan Siwaliks as 'higher pliocene.' It may be added that such of the older Sind mammalian genera as are found in the sub-Himalayan strata (and only one of those described here is so found) may either be later survivals, or may have come from a lower horizon (Nahan) than the majority of the fossils.

The majority of the remains described in this memoir consist only of detached molar teeth, which are often the sole evidence on which a genus or species is founded. The publication of the present memoir has purposely been delayed for a considerable period in the hope that additional remains of the more obscure forms might be obtained, but as the geological exploration of Sind is unlikely to be continued for the present, the time has come when such remains as are sufficiently identifiable should be laid before the scientific world.

Reverting to the selenodont *Suina* as a whole, it would seem probable that this group should again be divided into three minor sub-divisions. The first of these is distinguished by the crowns of the upper molars being furnished with five columns, or cusps, and may accordingly be termed the pentecuspidate division (*Pentecuspidati*). It probably comprehends at least two families; to the best known of which belongs the well-known genus *Hypopoternus*. For this family Dr. W. Kowalevsky, in his classical memoirs on its osteology,<sup>3</sup> has adopted the name

<sup>1</sup> See Duncan, 'Quar. Jour. Geol. Soc.,' Vol. XXXVII., p. 207, *et seq.*

<sup>2</sup> These asymmetrical terms are used in preference to 'upper and lower' or 'earlier and later pliocene,' as both the latter have acquired a fixed signification as indicating definite stages of the pliocene epoch, whereas the idea to be conveyed here is merely that the sub-Himalayan Siwaliks are higher up in the pliocene than the Lower Manchhars.

<sup>3</sup> 'Phil. Trans.,' 1873, p. 19, *et. seq.* 'Palæontographica,' Vol. XXII., parts 3-5.

*Hypotamidae*, in place of the older name *Anthracotheridae*: as, however, it will be shown in the sequel that there is a strong probability that the genus *Hypotamius* will eventually have to be united with *Anthracotherium*, the older name *Anthracotheridae* will be employed here. There is a further advantage in using the term *Anthracotheridae* for the family name, because Dr. Kowalevsky seems to include under his family such widely-divergent forms as *Anthracotherium* and *Anoplotherium*, an extension of the family which, as Dr. H. Filhol, in his exhaustive memoir on the hypotamids of Ronzon,<sup>1</sup> has shown is not advisable for general adoption. The Indian representatives of the family include the genera *Anthracotherium* and *Hypotamius*. The second family is represented by *Mistotherium* of the Quercy phosphorites, but there may be some doubt as to its position here. The genus *Diplopus* (included by Dr. Kowalevsky in the *Hypotamidae*), of which the teeth and skull are unknown, may form a third family of this division. The second division of the selenodont Suina is characterised by the crowns of the upper molars carrying only four columns on their masticating surface, and may be termed the tetracuspitate division (*Tetracuspitati*.) It comprehends the families *Merycopotamidae* and *Oreodontidae*, both of which have Indian representatives. The third division of the selenodont Suina comprises the family *Anoplotheridae*, and may be termed the *Anoplotherina*: it is, however, not impossible that this division should be merged with the second.

As we have already observed, the affinity of the selenodont Suina to the bunodont pigs is so close that there is sometimes a difficulty in assigning certain forms to their proper positions. On the other hand, the selenodont Suina are so intimately connected with the true ruminants, that here also it is frequently difficult to draw a satisfactory line of distinction. Thus certain of the hypotamids pass insensibly into the genus *Cainotherium*, which is undoubtedly a true ruminant genus; the oreodonts are closely allied to, if not the direct progenitors of, the ancestors of the camel (*Procamelus*, etc.); and the anoplotheres are as intimately related to the ruminant xiphodonts. While, therefore, for the purposes of classification it is convenient to retain the groups Suina (with its three sub-divisions) and Ruminantia,<sup>2</sup> it is highly probable that there is such a complete transition between them that they cannot logically be maintained. It is probable that many of the forms treated of here are not the true ancestors of the ruminants, but should rather be looked upon in the light of cousins descended from a common stock.

Whether any or all of the animals classed here as the Suina Selenodontia were endowed with the power of rumination, and their internal economy modified in accordance with that function, is a question which cannot ever be certainly determined. The oreodonts have, however, been termed 'ruminating hogs,' and from the close similarity of the structure of the molars of these and allied forms to

<sup>1</sup> "Étude des Mammifères Fossiles de Ronzon." 'Ann. d. Sci. Nat.' 1881. Vol. XL., Art. No. 3, p. 89 (reprint).

<sup>2</sup> In former parts of this work the term Selenodontia has been applied to the true ruminants, but it has been thought best for the future to confine it to the selenodont Suina.

those of the true ruminants, it is highly probable that the more specialized forms of the group were endowed with the ruminating function, while in the less specialized forms this function was absent.<sup>1</sup> If this be so it is evident that the more specialized forms must have been at least as closely related to the true ruminants as to the bunodonts, although the oreodons are so connected by *Merycopotamus* with the hippopotamus and the pigs as to clearly form one group, and it, therefore, confirms our conclusion as to the intimate relationship existing between the pigs and the true ruminants.

It may be affirmed with more certainty that the food of the higher selenodont pigs consisted in great part of leaves and grass (which require finer trituration, and consequently a more complex form of molar, as is exemplified in the ruminants, horses, and elephants), while their bunodont allies feed, as we know, more generally on roots and tubers, and occasionally on animal matter. Hence it is probable that the muzzles of most of the selenodonts were less elongated than in the true pigs, which require to turn up the soil to obtain their nutriment.

It must further be observed that certain peculiar and little-known animals (*Cebochaerus*) have been described from the Quercy phosphorites,<sup>2</sup> the molar teeth of which closely resemble those of the bunodont pigs, while the skulls show certain affinities to those of the simiine Primates, and it is highly probable that these animals are related both to the monkeys and the pigs. They have been referred to a group termed Pachysimia, but it is doubtful whether this should be placed among the Primates or the Artiodactyla.

In the following table a provisional scheme for the classification of the best-known families and genera of the Suina is given, and the relationship of the section to the Ruminantia and Pachysimia is also indicated, but the position of the latter section in the Artiodactyla must only be considered provisional. The genus *Taistriodon* is purposely omitted, and referred to the perissodactyles; if, however, it really be an artiodactyle, it should probably form a separate family of the Bunodontia. *Hippohyus* is only provisionally referred to the family *Suidæ*, as its molars exhibit a more specialized structure than those of the other members, and it should perhaps be raised to the rank of a distinct family. It has not been found practicable to indicate in the table all the relationships of the different families to one another; thus the relationship of *Hippopotamus* to *Merycopotamus* is not apparent; and while the former genus is placed nearest to the Pachysimia, the relationship of that group is evidently nearer to *Hypotherium* and *Acotherium*. Many of the American, and other, genera are omitted, on account of the difficulty of assigning them to their proper positions.

<sup>1</sup> Professor Gaudry ("Les Enchaînements du Monde Animal") classes the oreodons as true ruminants, but *Hypopotamus* and *Merycopotamus* as Suina.

<sup>2</sup> Filhol "Recherches sur Les Phosphorites du Quercy." 'Ann. d. Sci. Nat.,' Vol. VII. (reprint), 1878, p. 327.

# I. SUINA.

A.—SELENODONTIA.		B.—SELENODONTIA.	
		a. PENTACUSPIDATI	b. TETRACUSPIDATI.
1. Suina	<i>Sua. Percula.</i> <i>Bobina. Hippobryx (?)</i> <i>Sonchocera Amphicheilus.</i> <i>Heterobryx. Chazomeryx</i> <i>Pyrochoceryx. Palaeochoceryx.</i>	1 Anthracotheriidae <i>Anthracotherium</i> <i>Huopotamus.</i> <i>Rhagotharion.</i> <i>Chorapoceras.</i> <i>Hemichoceryx.</i>	1 Merycopotamus. <i>Merycopotamus.</i> <i>Chazomeryx.</i> <i>Hemichoceryx.</i> <i>Stenomeryx.</i>
2. Dicotylidae	<i>Incabias Hippotherium (?)</i> <i>Trochoceras. Platygonus</i>		
3. Acrotheriidae	<i>Acrotherium. Lepacotherium</i>		
4. Phacocheridae	<i>Phacocherus.</i>		
5. Entelodontidae	<i>Entelodon. Tetraodon.</i> <i>Adelodon.</i>	2. Mixtotherontidae <i>Mixtotherium.</i>	2. Oreadontidae <i>Oreadon.</i> <i>Epyrodon.</i> <i>Agriochocerus.</i> <i>Meryschocerus.</i>
6. Hippopotamidae	<i>Hippopotamus.</i> <i>Elphidotus.</i>	3. Hippocidae <i>Hippoc.</i>	
	<i>Leptochocerus. Luvahys. Bathy.</i> <i>Holohys.</i>		

## II. PACHYSIMIA.

Cebocetidae—*Ceb. Lucas.*

(This group may belong to the Primates, but in any case it connects that order with the Selenodont pigs.)

## III. RUMINANTIA.

Includes all the ruminants, connected by *Irphodon* and *Dicelodon* with *Acrotharion*, and by *Cainotherium* with *Huopotamus* and other Selenodont Suina.



The arrangement of the families in the foregoing table must be considered merely as provisional and liable to considerable future alterations, and it is probable that many of the genera included under one family should be referred to distinct families. Thus the family *Anthracotheridae* is considered by Dr. Filhol to include only the genera *Anthracotherium* and *Hyopotamus*, and it is suggested that even these might possibly belong to two families. On the contrary, Dr. Kowalevsky would include many more genera than those given in the table, under the same heading. Again the genus *Acotherium*, which is here classed among the bunodonts, is by many placed close to *Hyopotamus*, and *Eutledon* is evidently closely allied in the form of its skull to *Anthracotherium*, though its molars indicate close affinity to the typical bunodonts.

#### GROUP A: PENTECUSPIDATI.

*Upper molars with five columns.*

##### FAMILY 1.—*ANTHRACOTHERIDÆ*.

*General Characters.*—This family, as already stated, may be defined as selenodont pig-like animals, in which the upper true molars carry five cusps, or columns. These five columns are well displayed in the tooth represented in figure 3 of plate XXIV. The upper molars are divided into a front and hind portion, or 'barrel,' by a transverse cleft (*in the figure the left half of the tooth is the front, and the right, the hind barrel*): the fore 'barrel' carries three, and the hinder, two columns; of these, the columns at the four angles represent the two 'lobes,' and the two 'crescents' of the ruminant molar;<sup>1</sup> while the middle column on the fore barrel represents the anterior wall of the first 'crescent' of the ruminant molar.<sup>2</sup> In describing these teeth in this memoir, the antero-external column (*left hand top corner of pl. XXIV. fig. 3*) will be termed the 'first outer column'; the postero-internal column (*right hand top corner of figure*) the 'second outer column'; the antero-internal column (*left hand bottom corner of figure*) the 'first inner column'; the postero-internal column (*right hand bottom corner of figure*) the 'second inner column'; while the column wedged in between the first outer and inner columns (*middle of left side of figure*) will be termed the 'accessory, or fifth, column.' Similar terms will be used in describing the lower molars.

As far as is known, the full typical complement of teeth was developed in all members of the family; and in many the canine and premolars attained an excessive development, simulating to some extent those teeth in the carnivora. The skull was elongated, and presented a considerable resemblance to that of the hog, while the hinder part of the lower jaw in many forms has a resemblance to that of *Merycopotamus* and *Hippopotamus*.

<sup>1</sup> See preceding fasciculus of this volume.

<sup>2</sup> See Gaudry "Les Enchaînements du Monde Animal," pp. 67—8.

In typical members of the family the feet were furnished with four digits, but in some of the earlier species of *Hypotamius*, like *H. renevieri* and *H. gracilis* it seems probable that the number of the digits was reduced to two, in which case these forms ought to be referred to a distinct genus. Another well defined didactyle form, of which the teeth are unknown, has been referred to a distinct genus, under the name of *Diplopus aymardi*, and, as already said, probably belongs to a distinct family.

GENUS I: ANTHRACOTHERIUM,<sup>1</sup> Cuvier.

*Characters*.—With the addition of the new species described in this memoir it is difficult to formulate dental characters which will satisfactorily distinguish this from the next genus. It may, however, be noted that the lowness of the column, the shallowness of the valleys, the smallness of the outward projections of the angles of the outer surface, and of the loop connecting the outer columns, are characteristic points of the more typical forms. In some forms the whole of the upper premolars are approximated to the true molars, while in others the earlier premolars are separated from the posterior teeth.

*Distribution*.—As regards distribution in space, remains of this genus have been obtained from Europe and India. In time the genus in Europe, took its origin, according to Professor Albert Gaudry,<sup>2</sup> in the upper eocene (7th tertiary stage of M. Gaudry), attained its maximum in the lower miocene (9th stage), and disappeared in the middle miocene (11th stage). In India its earliest known occurrence is in the (probably) earlier pliocene, and it may possibly have survived into the higher pliocene.

*Number of Species*.—The following list contains the names of the best known species, but, as M. Filhol observes, there is a great variation in the size of the molars of many of the so-called species, which would lead to the inference that many of them should rather be regarded as races.

1. ANTHRACOTHERIUM ALSATICUM<sup>3</sup> Cuv. Up. eocene and Low. miocene; Europe.  
*A. alsaticum*, Blain.
2. ANTHRACOTHERIUM BREVICEPS,<sup>4</sup> (Troschel). Low. miocene; Europe.  
*Sus breviceps*, Troschel.
3. ANTHRACOTHERIUM CUVIERI,<sup>5</sup> Pomel. Miocene; Europe.  
*A. onoidum*, Gervais.
4. ANTHRACOTHERIUM DALMATINUM<sup>6</sup> Myr. Low. miocene; Europe.
5. ANTHRACOTHERIUM HIPPOIDEUM<sup>7</sup> Rüf. Low. Miocene; Europe.
6. ANTHRACOTHERIUM HYPOOTAMOIDES<sup>8</sup> Nobis. Earlier pliocene (?); India.

<sup>1</sup> From *anthrax*, coal, and *therion*, an animal: so named from the occurrence of its remains in the brown coal of the continent.

<sup>2</sup> "Les Enchaînements du Monde Animal," p. 4. I follow this classification, not using the term "oligocene."

<sup>3</sup> Filhol "Phosphorites du Quercy," pl. VIII. (Gervais "Zoologie et Paléontologie Générales," Vol. II., pl. X., fig. 1.

<sup>4</sup> "Paléontographica," Vol. XXIV., p. 145.

<sup>5</sup> Blainville "Osteographie," Anthracotherium, pl. III. (*A. magnum* des Orléanais).

<sup>6</sup> "Paléontographica," Vol. IV., pl. XI.

<sup>7</sup> Nov. Mem. Soc. Helv., Vol. XV., pl. I.

<sup>8</sup> *Fide infra*.

7. *ANTHRACOTHERIUM MAGNUM*,<sup>1</sup> (Cuvier). Up. eocene; Europe.*A. avernum*, Kefst.8. *ANTHRACOTHERIUM SILISTRENSE*,<sup>2</sup> (Pentland). Earlier pliocene (?); India.

The following species must be abolished, viz:—

*A. charoides*. Brav.*A. lembroium*. Brav.*A. minimum* Cuvier. = *Hypotherium* or *Cheromorus* (teste Gervais).*A. minutum* Cuvier. = *Duhodon* or *Amphitragulus*.*A. parisiensis* Blain. = *Cheropotamus*. \**A. sandbergi* \**A. telumum* Blain. = *Hypopotamus*.Species 1. *ANTHRACOTHERIUM SILISTRENSE*. Pentland, *in parte*.Synonyms. *Anthracotherium punjabiense*, Nobis.*Cheromeryx*, Pomel, *in parte*.*Rhagatherium* (?) *sindiense*, Nobis.

*History*.—In the year 1829, Mr. Pentland described and figured in the "Transactions of the Geological Society of London,"<sup>3</sup> certain mammalian remains obtained by Sir Thomas Colebrooke, from the Siwaliks of Kāribāri (Curibaree), in the Gāro hills of north-eastern Bengal, in, or adjoining, the district of Sylhet.<sup>4</sup> These remains comprehended a few specimens of upper molar teeth of small pig-like animals, which were all referred by their original describer to a single species, under the name of *Anthracotherium silistrense*.<sup>5</sup> In the year 1848, M. Pomel<sup>6</sup> referred, apparently all, these figured specimens, to a new genus, for which he proposed the name of *Cheromeryx*.<sup>7</sup> In the "Records of the Geological Survey of India" for 1877,<sup>8</sup> a five columned upper molar tooth from the lower Manchhars of Sind was described by the present writer, under the name of *Cheromeryx silistrensis*, since it agreed in form with one of the specimens described by Mr. Pentland as *Anthracotherium silistrense*, and subsequently referred by M. Pomel to *Cheromeryx*. In the same paper<sup>9</sup> a portion of the mandible of a small selenodont pig-like animal, collected by Mr. Theobald in the Siwaliks of the Punjab; was described under the name of *Anthracotherium punjabiense*. At a later date<sup>10</sup> it was shown that Mr. Pentland's original specimens in reality belonged to two distinct genera of selenodont pigs, one of which belonged to the pentacuspidate, and the other to the tetracuspidate group, and that the name *Cheromeryx* should be confined to the latter. It was at the same time considered that the Sind tooth mentioned above, and Mr. Pentland's pentacuspidate specimen, might belong to the genus *Rhagatherium*, and the specific name *sindiense* was proposed for them. In the following year it was shown<sup>11</sup> that the two latter teeth really belonged to *Anthracotherium*, and

<sup>1</sup> Blainville, "Ostréographie" *Anthracotherium*.<sup>2</sup> *Vide infra*.<sup>3</sup> Ser. 2, Vol. II., p. 393, pl. 46.<sup>4</sup> The locality is given by Sir T. Colebrooke, as the left bank of the Brahmaputra above Mohendrooan; but it appears that the river has changed its course since that time. <sup>5</sup> The Latinised name of Sylhet.<sup>6</sup> "Comptes Rendus," 1848, p. 687.<sup>7</sup> From *Cherax*, a pig, and *acrus*, a ruminant.<sup>8</sup> Vol. X, p. 77.<sup>9</sup> *Ibid.*, p. 78.<sup>10</sup> *Ibid.*, p. 225.<sup>11</sup> "R. G. S. I.," Vol. XI., p. 77.

consequently that Mr. Pentland's original determination of the pentecuspid upper molar as *Anthracotherium silistrense* was correct, but that the tetracuspid teeth, forming M. Pomel's genus *Charomeryx*, had been included in the same species. It was also shown at the same time that the mandible on the evidence of which the species *A. punjabiense* had been founded, belonged in all probability to the same species as Mr. Pentland's specimen of *Anthracotherium*.

*Upper molars.*—The type specimen is represented in figures 4 and 5 of plate XLV. of the second volume of the second series of the "Transactions of the Geological Society"; a far better representation of the specimen is, however, given in figures 23 and 23a of plate LXVIII. of the "Fauna Antiqua Sivalensis." The latter figure shows that the tooth is a partially worn upper true molar of the left side, probably the last tooth of the series. The original specimen is stated to have been presented to the Geological Society, but, as it cannot now be found in their collection, the identification of the species must rest upon the figure, which is fortunately amply sufficient. The two teeth represented in figures 10 and 12 of plate XXIII. of the present memoir, were obtained by Messrs. Blanford and Fedden, from the lower Manchhars of Sind, one of them being the specimen referred to in the notice already quoted. These teeth belong to the true molar series of the right side, the specimen represented in figure 10 being partially worn, while the other is an unused germ: the former is probably a third, and the latter a second true molar, and both evidently belong to the same species. If figure 10 be compared with figure 23 of the above quoted plate of the "Fauna Antiqua Sivalensis," and if it be remembered that the teeth belong to opposite sides of the jaw, there will be no question as to the specific identity of the two, whence the Sind teeth are identified with *Anthracotherium silistrense* of Mr. Pentland.

With regard to the correctness of the generic determination of the latter, a comparison of the figures of either of the three Indian teeth with those of typical European species of *Anthracotherium*, such as *A. alsaticum*,<sup>1</sup> or *A. magnum*,<sup>2</sup> will at once show that the former are correctly referred to the same genus. There does not, however, appear to be any European species with which the Indian teeth can be identified, and, their original reference to a distinct species may, therefore, stand. The European species which approaches nearest in size to the Indian form is *Anthracotherium breviceps* from the lower miocene, or oligocene, brown-coal of Bonn: the figure of the upper molars of this species given by Dr. Böttger<sup>3</sup> shows, however, that the inner columns form much more distinctly defined crescents than in the Indian teeth, and there is a more pronounced 'cingulum' in the former. The teeth of *A. alsaticum*, the figures of which have already been referred to, are of larger size than the Indian specimens, but agree very closely in general form, except that in the former there is a more distinct ledge at the bases of the external walls of the

<sup>1</sup> H. Filhol, "Recherches sur Les Phosphorites du Quercy," reprint, Paris, 1877, p. 305, fig. 241. Gaudry "Les Enchaînements du Monde Animal, etc.," p. 97, fig. 118.

<sup>2</sup> Blainville "Ostéographie," *Anthracotherium*.

<sup>3</sup> "Palæontographica," Vol. XXIV., p. 165, fig. 4, a.

outer columns, and, according to the excellent woodcut given by Professor Gaudry, by the greater production of the antero-external angle of the crown. The upper molars of *A. magnum*, to which a reference has likewise been given, are also constructed, as mentioned above, on a very similar type to those of the present species, but are at once distinguished by their much greater size. The molars of *A. cuvieri* are readily distinguished by the more distinct loop, formed by the prominence connecting the external walls of the two outer columns;—a character especially well shown in two molars from Piedmont, in the National Collection at South Kensington. The molars of *Anthracotherium dalmatinum*,<sup>1</sup> if this be indeed distinct from some of the other species, have also a more distinct loop between the outer columns than in the Indian teeth, and are of slightly larger size than the latter. No other species of the genus present any close approximation to the Indian teeth.

It should, however, be observed that the latter present a certain resemblance to the molars of *Choropotamus parisiensis*, but they are distinguished by the greater tendency to the development of intermediate tubercles in the latter.

The enamel of the Indian teeth is marked superficially by a finely reticulate, or rugose structure. The dimensions of the specimen represented in figure 10 are as follows, viz.: length, 0·68 inch; width, 0·7 inch; height of crown, 0·36 inch.

*Mandible*.—In figures 1 and 1a of plate XXIV., of this memoir, there is represented the hinder portion of the horizontal moiety of the right ramus of the mandible of an *Anthracotherium*, collected by Mr. Theobald, in the Siwaliks of the Punjab. The fragment shows the three true molars in an early stage of wear; a portion of the associated left ramus of the mandible was also obtained, showing the second and third true molars. The specimen is identical in form with the right ramus of an *Anthracotherium*, previously described by the writer under the name of *A. punjabense*, and subsequently referred to *A. silistrense*,<sup>2</sup> but as being the more perfect of the two has been selected for figuring. The molars present the characters of those of typical members of the genus, and do not, therefore, require detailed description. The accessory lobe in the last true molar is well developed, and there is a distinct tubercle at the entrance of the median valley on the external side of each molar. The jaw has its inferior margin strongly convex, and is of considerable relative depth, indicating great power of biting in its owner. Below the hinder extremity of the last molar, the inferior border of the jaw shows a slight in-cutting, probably succeeded in the complete jaw by a descending process, thus recalling the corresponding peculiarity of the lower jaws of *Hippopotamus* and *Merycopotamus*.

It should be observed that in the typical forms of *Anthracotherium* and *Hypopotamus* (such as *A. magnum*, and *H. colaninus*), the lower molars of the former are distinguished from those of the latter by their less perfect selenodont form (compare

<sup>1</sup> "Palæontographica," Vol. IV., p. 61, pl. XI. This species is referred by Döttger to *Hypopotamus*, but, judging from the figure, seems to be a true *Anthracotherium*.

<sup>2</sup> *Ibid.* *Supra*.

"*Les Enchaînements du Monde Animal*," figs. 111 and 113). In other species, however, as in *A. bracciceps*,<sup>1</sup> the molars of *Anthracotherium* are more truly selenodont, and appear to be with great difficulty distinguishable from those of *Hypotamius*; this appears to be the case with the present and the next species. The dimensions of the specimen are as follows:—

Length of 1st molar	In.
Width of „ „	0.5
Length of 2nd „	0.4
Width of „ „	0.6
Length of 3rd „	0.42
Width of „ „	0.32
Depth of jaw	0.44
Thickness of „	1.38
	0.5

As these dimensions agree so well with those of the upper molars of *Anthracotherium siliense*, it appears highly probable that the mandible should be referred to that species.

It may be observed that as the premolars are not present it is impossible to say whether the form of these teeth agreed with that of the premolars of *Anthracotherium*, or of the allied genus *Hemihyrax*, which appears to be distinguished mainly by the form of these teeth.<sup>2</sup>

*Summary*.—No other remains of this species have hitherto come under the writer's notice, but those above described are amply sufficient to prove the former existence, in India, of a small strong-jawed species of anthracothere closely allied to the species from the brown-coal of Europe.

*Distribution*.—This species had a wide distribution in space, as its upper molars have been found in Sind, in the extreme west of India, and in the Gáro Hills in the extreme east. The lower jaws, on the assumption that they belong to the same species, have been found in the intermediate district of the Punjab. This species, from its occurrence in the lower Manchhar series, is not improbably only of earlier pliocene age, as it is quite probable that the specimens from the Punjab were derived from beds low down in the Siwalik series.

#### Species 2. *ANTHRACOTHERIUM M. HYPOSTAMODES*. n. sp. *Nobis*.

*History*.—This species is mentioned here for the first time, as it is founded on an upper molar tooth obtained in the early part of the year 1882, by Mr. W. T. Blanford, from the lower Manchhar rocks of the Bhúgti hills, north of the Sind frontier, and considered at first to belong to the same species as an upper molar referred to a species of *Hypotamius*, mentioned in the "Records"<sup>3</sup> for that year, and described in the sequel. Other remains described below are provisionally referred to the same species.<sup>4</sup>

<sup>1</sup> "Palæontographica," Vol. XXIV., p. 105, fig. 16.

<sup>2</sup> See Filhol "Mémoires sur Quelques Mammifères Fossiles des Phosphorites du Quercy," Toulouse, 1882, p. 106.

<sup>3</sup> Vol. XV., p. 107. <sup>4</sup> Casts of the figured remains of this species, and of *Hypotamius giganteus* are in the British Museum.

*Upper molar.*—The specimen of an upper molar referred to above is represented, of the natural size, in figure 2 of plate XXIV.: it is implanted in a fragment of the right maxilla, which also shows the base of the preceding tooth: the perfect tooth is the last true molar. The tooth has unfortunately lost a considerable portion of the first outer column, but is otherwise perfect: it is in an early stage of detrition, the two hinder columns being untouched. The tooth is invested with a highly rugose enamel, a character which, though apparently trivial, will be shown in the sequel to be of some importance. An inspection of the figure will at once show that the tooth belongs to one of the pentacuspitate selenodont Suina, in which the fifth column is well developed. The external surface of the one remaining perfect outer column bears a well developed vertical median ridge, diminishing in width from the base upwards; the lateral borders of the base of the same surface are not produced outwards, so that they do not project beyond the middle point of the base of this surface. The two outer columns are connected by a fold, which in the present condition of the tooth forms an angle, but in a worn condition would form an open loop. The second inner column is rounded externally, and concave internally; it is separated by a shallow valley from the outer column of the same side. The first inner column is irregularly shaped. The transverse median valley of the crown is shallow, and does not become deeper as it passes outwards: there is no 'cingulum.' The dimensions of the specimen are as follows:—

	Ln.
Length . . . . .	1.6
Width . . . . .	1.68
Height of second outer column . . . . .	0.8

*Comparisons.*—Comparing the specimen with the upper molars of the genus *Anthracotherium*, we find that in typical species of the latter, as *A. magnum*,<sup>1</sup> *A. alantium*<sup>2</sup> and *A. silistense* (plate XXIII. fig. 10) the fold connecting the two outer columns is more compressed, and so to speak, more pinched in, and does not form a wide distinct horse-shoe-like loop, but has its outer service flat and bounded by distinct borders, forming a V-shaped shield on the outer surface of the crown. In some species, however, as in *A. curiei*, and especially in the molars of that species from Piedmont in the British Museum already mentioned, there is a better defined loop, but still much less marked than in the present specimen. The shallowness and even depth of the valleys of the latter, and the forms of the columns, as well as the rugose structure of the enamel, are, however, characters of the genus *Anthracotherium*, as distinct from *Hypopotamus*, and the specimen has accordingly been provisionally referred to the former genus. It has, however, characters distinctly approximating it to *Hypopotamus*, to mark which affinity it has been designated *Anthracotherium hypopotamoides*. In size it is intermediate between *A. magnum* and *A. curiei*. It will be shown in the sequel that the resemblance of the tooth is so close to an upper molar from the same locality (pl. XXIV., fig. 3) provisionally

<sup>1</sup> See Blainville "Ostéographie," *Anthracotherium*.

<sup>2</sup> Filhol. *op. cit.*

referred to *Hyopotamus*, that it was at first considered doubtful whether the two could be even specifically separated.

**Mandible.**—The assignation of their respective lower jaws to allied forms when there are two or more species of nearly the same size is always a matter of extreme difficulty and uncertainty, and in the present instance the reference must be considered purely provisional, or, indeed, merely as a guess. In plate XXV. there are represented three fragments of mandibles of large selenodont Suina, obtained from the Bhūgti hills in company with the foregoing specimen, which must evidently belong either to the present species or to *Hyopotamus giganteus*, described in the sequel. These three fragments, although agreeing in the size and structure of their teeth, show such differences in their shape that it is probable that they belong to at least two distinct species, one of which was furnished with a more slender mandible than the other. As it appears that the mandible of *Anthracotherium* is generally of a stouter type than that of *Hyopotamus* (compare plate XXIV., figures 1a and 4), the stouter jaw is provisionally assigned to the present species. Of the two specimens showing the last true molar, the specimen represented in figure 1 has the greatest depth of jaw. It shows the hinder part of the last true molar, and a fragment of the horizontal ramus, with the commencement of the surface for the attachment of the masseter muscle. Its dimensions are as follows:—

	In.
Depth at second column of molar . . . . .	3.22
Greatest thickness . . . . .	1.5
Width of last molar . . . . .	1.2

The inferior border exhibits the notch characteristic of *Anthracotherium* and its allies.

In figure 3 of the same plate there is represented a fragment of a right ramus of the mandible showing the second true molar, in an intermediate stage of wear, and a portion of the much-worn first true molar. The dimensions of this specimen are as follows:—

	In.
Depth at hinder border of 2nd molar . . . . .	3.42
Length of second molar . . . . .	1.4
Width of . . . . .	1.16

It will be seen that this specimen is still deeper than the last, but it is possible that the two may have belonged to the two sexes of the same species. No further comparisons can be made with the materials available. The points distinguishing the specimen represented in figure 1 from that in figure 2 will be discussed with the description of the latter, under the head of *Hyopotamus giganteus*.

## GENUS II. HYOPOTAMUS.<sup>1</sup> Owen. (1847).

*Ancodus.* Pomel (1847).

*Rothriodon.* Armand (1848).

*Cyclognathus.* Cruz.

*Tapinodon.* Meyer.

**History and Characters.**—This genus was established in 1847, by Professor Owen,<sup>2</sup> on the evidence of certain molar teeth and jaws obtained by the late Marchioness of

<sup>1</sup> From *hōs*, *hōs*, a pig, and *potamós*, a river.

<sup>2</sup> 'Quar. Jour. Geol. Soc.,' Vol. iv., p. 143, et seq.



Hastings from the upper eocene (oligocene) strata of the Hampshire basin. Two species were formed from these specimens, and it was shown at the same time that Dr Blainville's *Anthracotherium velaunum* must be referred to the new genus. Shortly before the publication of Professor Owen's memoir, the new genus *Ancodus* had been established by M. Pomel,<sup>1</sup> for certain teeth which were subsequently shown to be generically the same as those described as *Hypopotamus*. There is no doubt that M. Pomel's name has the priority, but as Professor Owen's name is almost universally used in England it has been adopted here, although *Ancodus* is largely used by continental palaeontologists.<sup>2</sup> Subsequently other remains were described under the names of *Bothriolion*, *Cycloquathus*, and *Tupinodon*, which were shown by Dr. Kowalevsky<sup>3</sup> to belong to *Hypopotamus*. It was also shown by the same writer that certain species referred to *Cainotherium* belonged to the same genus.

In his original description it was at first considered by Professor Owen that *Hypopotamus* differed from *Anthracotherium* by the upper premolars having two 'barrels,' in place of one, but it was subsequently shown that the teeth originally considered as premolars were in reality milk-molars. As was mentioned in the characters of the family, the whole number of the typical placental dentition is always present, but there is considerable diversity as to the position of the anterior premolars, and the relative size of the canines. Thus in *H. leptorhynchus* the first premolar is separated by a long interval from the other three teeth of that series, which are all in apposition, and the canine is large. In the form known as *H. aymardi*, which is very probably the female of the last, the first and second premolars are separated by 'diastemæ' of equal lengths from the third and fourth premolars, and the canine is small. In *H. velaunus* the first premolar only is separated from the others by a small 'diastema,' and the canine is small. The skull, in those forms in which it is known, is remarkable for the elongation of the facial portion, for the smallness of the brain cavity, and for the absence of a 'larnier,' (Filhol.) The upper true molars of the typical forms are distinguished from those of typical forms of *Anthracotherium* by the more distinct and wider loop formed on the outer border of the masticating surface at the union of the two outer columns. (This difference is admirably shown in figures 6 and 9 of plate VII. of Professor Owen's memoir, where the molars of *Anthracotherium magnum* (fig. 9) are reduced to the same size as those of *Hypopotamus vectianus* (fig. 6).) There is, however, such a gradual transition, through less typical forms, from *Hypopotamus* to *Anthracotherium* in these respects, that it is almost impossible to give definite generic characters founded on the structure of the molar teeth, and it is not impossible, as previously observed, that the two genera may eventually have to be amalgamated.

*Distribution.*—The genus *Hypopotamus* has a very extensive distribution in space, its remains having been obtained from the tertiaries of India, Europe, and North

<sup>1</sup> 'Archives de la Bibliothèque de Genève,' Vol. VII., 1857.

<sup>2</sup> Dr. Kowalevsky ('Phil. Trans.' loc. cit., p. 22,) attempted to show that *Ancodus* was never defined, but Dr. Filhol ('Mammifères de France,' p. 87,) has shown that this is erroneous.

<sup>3</sup> 'Phil. Trans.' loc. cit.

**America.** Its range in time is from the upper eocene (5th tertiary stage of Gaudry) to the lower miocene in Europe, while in India it survived (probably) to the earlier pliocene. Its maximum of development in Europe occurred in the lower miocene (8th tertiary stage.) In America it seems to be confined to the miocene.

*Number of species.*—There is very great difficulty in arriving at a satisfactory conclusion as to the number of species of the genus, owing to the numerous synonyms, and the confusion caused by writers wrongly identifying new forms with previously described species. Dr. H. Filhol, in his memoir on the fossil mammals of Ronzon,<sup>1</sup> has endeavoured to correct the synonymy of the French and English species, and comes to the conclusion that they should all be referred to four species, which he respectively terms—(1) *Ancodus velaunus* Pomel, (2) *A. leptorhynchus* Pomel, (3) *A. borcinus* Owen, and (4) *A. porcinus* Gervais. In the first species he includes the English *Hyopotamus vectianus* of Professor Owen, and in the second *Ancodus aymardi* of M. Pomel, the skull of which is figured under the latter name on plate XVI of his memoir, but which on page 188 of the same is shown to belong probably to a female of *A. leptorhynchus*. Thus far Dr. Filhol is clear enough, but on page 99 he observes “that the *Ancodus velaunus* of M. Pomel does not correspond to *Bothriodon velaunus* of M. Aymard, as one might at first suppose, but to *Bothriodon platyrhynchus* of the same author; and that the *Ancodus aymardi* of M. Pomel is the *Bothriodon velaunus* of M. Aymard.” This may shortly be expressed as follows, viz.:—

*A. velaunus*. Pom. = *B. platyrhynchus*. Aym.

And *B. velaunus*. Aym. = *A. aymardi* Pomel.

On page 186, it is stated that “the animals described under the names *Ancodus incertus* Pomel, *Hyopotamus borbonicus* Gervais, *Ancodus aymardi* Pomel, and *Bothriodon velaunus* Aymard form one and the same species.” On page 189 *H. borbonicus* is classed as a synonym of *A. velaunus* Pomel, and as it was before considered to be the same as *A. aymardi* Pomel, it follows that *A. aymardi* Pomel is the same as *A. velaunus* Pomel, and consequently that the latter is the same as *Bothriodon velaunus* of M. Aymard, which we were expressly told at first was not the case. In respect of these species M. Filhol has, indeed, made the ‘confusion worse confounded,’ and without the whole series of type specimens for comparison it is quite impossible to give a correct list of the synonymy and number of the species.

The following list must, therefore, only be considered as an approximation to the truth; the hypothetical reference of the form known as *Hyopotamus aymardi* to *H. leptorhynchus* is indicated by a note of interrogation; and also that of *H. vectianus* of Owen to *H. velaunus*. The European species additional to the four French and English species admitted by M. Filhol are given on the authority of Dr. Kowalevsky. *H. borbonicus* is identified with *H. vectianus*, whether or not the latter species is the same as *H. velaunus*.

<sup>1</sup> *loc. cit.* reprint, p. 189.

# 157—16 INDIAN TERTIARY AND POST-TERTIARY VERTEBRATA.

1. *HYOPOTAMUS AMERICANUS*,<sup>1</sup> Leidy. Miocene; N. America.
2. *HYOPOTAMUS BOVINUS*,<sup>2</sup> Owen. Up. eocene (5th stage); Europe.
3. *HYOPOTAMUS CRISPUS*,<sup>3</sup> Gervais. Low. miocene; Europe.
- \*4. *HYOPOTAMUS GERGOVIANUS*,<sup>4</sup> (Croiz). Low. miocene; Europe.  
*Anthracotherium gergovianum*. Croiz.  
*Cylognathus gergovianus*. Croiz.
5. *HYOPOTAMUS GIANTEUS*,<sup>5</sup> Nobis. Earlier pliocene (?); India.
6. *HYOPOTAMUS GRESLYI*,<sup>6</sup> Rüt. Up. eocene; Europe.  
*Tapinodon greslyi*. Myr.
7. *HYOPOTAMUS LEPTORHYNCHUS*,<sup>7</sup> (Pomel). Low. miocene; Europe.  
*(?) Ancebus gymardi*. Pomel.  
*Ancebus insignis*. Filhol.  
*Ancebus leptorhynchus*. Pomel.  
*Ancebus macrochinus*. Pomel.  
*Bothriodon insignis*. Filhol.  
*Bothriodon leptorhynchus*. Aymard.  
*Bothriodon velaunus*. Aymard.
8. *HYOPOTAMUS PALEINDICUS*,<sup>8</sup> Nobis. Earlier pliocene (?); India.
9. *HYOPOTAMUS PORCINUS*,<sup>9</sup> Gervais. Low. miocene; Europe.
10. *HYOPOTAMUS RENEVIERI*,<sup>10</sup> (Pictet). Up. eocene (?); Europe.  
*Cainotherium renevieri*. Pictet.  
*Cainotherium courtoisi*. Pictet.
11. *HYOPOTAMUS VELAUNUS*,<sup>11</sup> (Blain). Up. eocene, and low. miocene (8th stage); Europe.  
*(?) Ancebus borbonicus*. Gervais.  
*Ancebus incertus*. Pomel.  
*Ancebus velaunus*. Pomel.  
*Anthracotherium velaunum*. Blain.  
*Bothriodon platyrhynchus*. Aymard.  
*(?) Hyopotamus borbonicus*. Gervais.  
*(?) Hyopotamus velaunus*.<sup>12</sup> Owen.

*Hyopotamus guyotanus*, Cope, belongs to *Merycopater*.

<sup>1</sup> 'Jour. Acad. Nat. Sci. Philad.,' Ser. 2, Vol. VII., pl. XXI., fig. 1.    <sup>2</sup> 'Quar. Jour. Geol. Soc.,' Vol. IV., pl. VII., fig. 1.  
<sup>3</sup> Pictet, 'Paléontologie Suisse,' Vol. V., pl. XXIV., figs. 8-12.    <sup>4</sup> Blainville 'Ostéographie,' Anthracotherium, pl. III.  
<sup>5</sup> *Vide infra.*    <sup>6</sup> Pictet 'Paléontologie Suisse,' Vol. V., pl. XXIV., figs. 4-7.    'Nov. Mem. Soc. Hel.' Vol. XIX., pl. V., figs. 64-7.    <sup>7</sup> Filhol, 'Mammifères de Bonzon,' pls. XV. XVI., (*A. gymardi*).    <sup>8</sup> *Vide infra.*  
<sup>9</sup> Gervais 'Zool. et Paléontologie Françaises,' pl. XXXI., fig. 8.  
<sup>10</sup> Pictet 'Paléontologie Suisse,' Vol. V., pl. XXVI., figs. 8-12.    <sup>11</sup> Filhol 'Mammifères de Bonzon,' pl. XXVIII.  
<sup>12</sup> This species is introduced as a synonym of *H. velaunus* solely on the authority of Dr. Filhol (*loc. cit.*), but in the sequel is frequently treated as a distinct species: if really distinct *M. borbonicus* should be referred to it, and perhaps some of the other synonyms. (See Gervais, *loc. cit.*, p. 1162.)

Species 1.—*HYOPOTAMUS PALÆINDICUS*. n. sp. *Nobis*.

*History*.—This species was first named by the writer in the year 1877<sup>1</sup> on the evidence of two small upper molar teeth, obtained by Mr. W. T. Blanford in the lower Manchhar rocks of Sind. Other teeth, together with a portion of the mandible, were subsequently obtained from the same strata by Messrs. Blanford and Fedden, and have also been briefly noticed in the "Records."<sup>2</sup> All the above specimens form the subject of the present fuller notice.

*Upper molars*.—In figures 4 and 6 of plate XXIII. of this memoir there are represented, from the masticating aspect, the two most perfect specimens of the above-mentioned upper true molars. The specimen represented in figure 4 belongs to the right side, has been but little abraded by wear, and is most probably the last true molar. The specimen represented in figure 6 is from the opposite side, has been considerably more worn down, and is probably the second true molar: both specimens are quite perfect. The external aspect of the specimen represented in figure 4 is given in figure 7. These teeth present all the essential characters of the upper molars of the genus *Hypotamus*; the fifth, or accessory column, is of relatively small size, but can be distinguished, in its unworn condition, on the right side of figure 4, but in figure 6 it has become confluent by wear with the antero-internal column (*left side of figure*). The crown is remarkably low, surrounded on three sides by a well defined 'cingulum,' and invested with a striated enamel. Although, as has been already mentioned, these teeth present a strong resemblance in their general plan of structure to those of the European and American species of *Hypotamus*, yet when examined in more detail they present such differences as to leave no doubt of the specific distinctness of the form to which they belonged, though it is much to be desired that materials may eventually be forthcoming which will enable more full comparisons to be made. The most important points of distinction of the Indian teeth are the much more prominent development of the vertical ridges on the external surfaces of the outer columns, and also the smaller relative size of the fifth column. The following comparisons indicate these differences in the species approaching in size to the Indian teeth. In all the three skulls figured by M. Filhol, in his memoir on the fossil mammals of Ronzon quoted above,<sup>3</sup> under the names of *Hypotamus (Ancodus) leptorhynchus*, *H. aymardi*, and *H. velatus*, the fifth column is very much more developed than in the Indian teeth, being frequently as large as the other columns, while, as far as can be judged from the figures, the median vertical ridges on the external surfaces of the outer lobes, so conspicuous in the Indian teeth, appear to be wanting. In the molars of the large *H. bovinus*<sup>4</sup> from the Isle of Wight these ridges are likewise wanting. In the molars in the British Museum belonging to the form described by Professor Owen under the name of *H. vectianus*,<sup>5</sup> but identified by

<sup>1</sup> R. G. S. I., Vol. X., p. 77.

<sup>2</sup> Vol. XI., p. 80.

<sup>3</sup> Pls. XV. to XVII. An excellent woodcut of an upper molar of *H. velatus* is given by M. Gaudry, *loc. cit.*, p. 98, fig. 122.

<sup>4</sup> Owen *loc. cit.*, pl. VII., fig. 1.

<sup>5</sup> *Ibid.*, pl. VII., fig. 6.

M. Filhol with *H. velans*, there is a distinct ridge present on each column, but, as in the other European forms, the external angles of each of the outer columns, are much more developed than in the Indian teeth, and project outwardly beyond the plane of the median ridges, in much the same manner as in the molar represented in figure 5 of plate XXIII. of the present memoir. The presence of these ridges in the Isle of Wight teeth, and their apparent absence in those of the continental *H. velans* would seem to throw some doubt on M. Filhol's identification of the two forms. In the sequel *H. vertianus* is still provisionally classed as a distinct species, if only for the sake of convenience of reference. In *H. americanus*<sup>1</sup> (distinguished by its taller columns, and larger fifth column), and in the small *H. gresslyi*,<sup>2</sup> the median ridge is more developed than in any other non-Indian form, but still much less so than in the Indian teeth. The other European forms are of smaller size, and do not approach closely to the Indian teeth.

On the whole it would seem that there is little, if any doubt, but that the Indian teeth should be referred to the genus *Hyopotamus*, but that they belong to a slightly abnormal division of it. This reference will be found to be of considerable importance with regard to the generic determination of the teeth of the next species. The dimensions of the specimen represented in figure 4 are as follows:—viz., length, 0·8 inch; breadth, 0·89 inch; height of crown, 0·45 inch. The specimen represented in figure 6 is of slightly larger dimensions.

*Lower molar.*—In figure 3 of plate XXIII, there is represented the greater portion of the third left lower molar of a hyopotamid, obtained by Mr. W. T. Blanford in Sind. The tooth has lost its third, or last barrel, but is otherwise perfect, and is in an intermediate condition of wear: it agrees in all general respects with the lower molars of *Hyopotamus*, and is of about the same size as the last lower molar of the European *H. borinus*. The crown is, however, lower than in most European forms, in which respect it corresponds with the upper teeth. The size of the tooth renders it rather large to have belonged to the same species as the upper molars described above, which are nearly equal in size to those of *H. vertianus*, but since we have seen that there is some variation in the size of the upper teeth, and as it is extremely undesirable to form new species on such scanty evidence, and without a fair amount of certainty, it seems better to provisionally refer the lower tooth to the same species as the upper. It may be added that the tooth is readily distinguished from the lower molar of *Merycopotamus* by the greater stoutness and breadth of the barrels, by the more rounded contour of the inner columns, and by the smaller degree of elevation and sharpness of the whole crown, and especially of its outer columns.

*Mandible.*—In figure 4 of plate XXIV, there is represented, from the external aspect, the portion of the left ramus of the mandible noticed in the passage in the

<sup>1</sup> Leidy, "Jour. Acad. Nat. Sci. Philad.," Vol. VII., pl. XXI., fig. 1. An excellent woodcut of an upper molar is given by Professor Cope "Origin of Types of Molar Teeth, &c.," Philadelphia, 1874, p. II., fig. 8. The comparisons given in the text are chiefly made from a cast of the molars in the British Museum.

<sup>2</sup> Pictet, "Palæontologie Suisse," Vol. V., pl. XXIV., figs. 12 and 13.

"Records" already quoted, and provisionally referred to *Hypotamius palæindicus*: the specimen was obtained by Mr. Fodden, from the lower Manchbars of Sind. It comprises the posterior part of the horizontal ramus, showing the bases of the second and third true molars, and the anterior part of the surface for the attachment of the masseter muscle. The jaw is slender and elongated, the inferior border of the dentigerous portion being nearly straight and inclining rapidly upwards: posteriorly to this portion there is a broad open notch, and then the commencement of a descending process. Both the notch and the descending process are much less developed than in *Merycopotamus*, in which genus the mandible is relatively much stouter and deeper. The form of the section of the last true molar agrees precisely with the base of the last lower molar represented in figure 3 of plate XXIII., and provisionally referred to *Hypotamius palæindicus*, and it, therefore, seems almost certain that the two specimens belong to the same species. The figured jaw agrees very closely with the corresponding portion of the mandible of *Hypotamius borinus* figured by Professor Owen, in the memoir already quoted;<sup>1</sup> but its resemblance to the slender jaw of the so-called *H. agnardi*,<sup>2</sup> in which the descending plate at the angle is largely developed, is still more close. The depth of the Sind jaw is 1·3 inches, and the length of the last true molar 1·36 inches. It will thus be seen that the present jaw is of a more slender type than that of the small *Anthracotherium siliense* described above; in this point, therefore, the two Indian specimens respectively agree with the proportionate forms of the jaws of the European species of *Hypotamius* and *Anthracotherium*.

*Distribution*.—Remains of this species have hitherto been obtained only from the lower Manchbar rocks of Sind.

Species 2. *HYPOTAMUS GIGANTEUS*. n. sp. *Nobis*.

*History*.—As there seem to be two species of Indian *Anthracotherium*, the one large and the other small, so there appears to have been a large and a small species of *Hypotamius*, the former forming the subject of the present notice. The only previous notice of this species is a statement in the "Records" for 1882,<sup>3</sup> to the effect that Mr. W. T. Blanford had in the early part of that year obtained from the lower Manchbar rocks of the Blūgti hills, to the north of the Sind frontier, several molars of a species of *Hypotamius* of larger size than those of any known species of the genus. Among these teeth was, however, included the above-described upper molar on which *Anthracotherium hypotamoides* is founded, and there consequently only remain two teeth which can certainly be ascribed to the present species.

*Upper molar*.—In figure 3 of plate XXIV. there is figured one of the two molar teeth discovered by Mr. Blanford. The specimen is a last upper molar, as is gathered from the absence of a disc of pressure on the posterior aspect of the crown, and is in a middle condition of wear: it has lost its two outer angles, and a portion of the loop connecting the two outer columns, but is otherwise perfect.

<sup>1</sup> 'Quar Jour Geol Soc,' Vol IV, pl VIII, fig. 3

<sup>2</sup> 'Mammifères Fossiles de Rouzon,' pl. XXI

<sup>3</sup> Vol XV, p. 107

It will be observed from a comparison of the two figures (plate XXIV. figures 2 and 3) that this tooth is of precisely the same dimensions as the corresponding tooth, of the opposite side of the jaw, of *Anthracotherium hyopotamoides*; and the general resemblance between the two is indeed so close, that, as has already been said, they were on a first examination referred to the same species. A closer examination has, however, shown that not only must they in all probability be referred to distinct species, but according to the present classification to distinct genera, though they afford the strongest grounds for the ultimate fusion of these two genera.

It will be simplest to indicate in the first place how the tooth before us differs from the upper molar of *Anthracotherium hyopotamoides*; and it must be observed that this comparison is rendered somewhat difficult by the different states of wear of the two specimens. The tooth under consideration is firstly distinguished from the latter by the structure of the enamel, which is marked by longitudinal striae, in place of being rugose.<sup>1</sup> It is also distinguished by the presence of a very marked 'cingulum,' encircling the inner half of the base of the crown. Further, the median transverse valley, in place of being of the same depth throughout its course, becomes much deeper in the middle, and at its outer extremity. Perhaps, however, the most important differences occur on the external surfaces of the two teeth; differences unfortunately to a great extent obscured by the fracture of the external angles of the specimen under consideration. Those angles, however, when perfect must evidently have been greatly produced outwards, and have curved over the flat portions of the external surfaces of the two outer columns in much the same manner as in typical species of *Hyopotamus*.<sup>2</sup> Again, these surfaces are less nearly vertical, sloping more towards the inner side than in *A. hyopotamoides*, and the centres of their bases are depressed below their lateral borders, while all are in one plane in the latter.



Fig. 1. *Hyopotamus gigartensis*; 3rd left upper true molar. — Bhilgti hills.

The second specimen, which is represented in the accompanying woodcut, is also a third left upper molar, as is proved by the absence of a pressure disc on the posterior side, and is slightly larger than the first specimen. It was also obtained in the Bhilgti hills, and is in an early stage of wear. A part of the anterior side has been broken away, and also the enamel of the external surface of the first outer column. A comparison of this specimen with the upper molar of *Anthracotherium hyopotamoides* will at once show the striking differences between the external surfaces of the outer columns of the two specimens, and the greater production of the connecting loop in the tooth under consideration. In the second outer column of

<sup>1</sup> The difference in the structure of the enamel in these two specimens is not shown in the figure, but is well exhibited in the excellent casts in the British Museum.

<sup>2</sup> See Owen 'Quar. Jour. Geol. Soc.,' Vol. IV., pl. VII.

the tooth of *A. hypopotamoides* (left side of figure) the middle vertical ridge is very large and wide, and is so largely developed that if a rod be laid on the external surface of this column, it will rest on this median ridge, as well as on the lateral borders of the surface. In the corresponding part of the tooth under consideration (right side of woodcut), the median ridge is greatly depressed below the plane of the lateral borders of the external surface of the column: this depression is so extensive that a rod placed as before will be raised more than a third of an inch above the median ridge. The central part of the external surface of the first column is similarly depressed in this tooth, and elevated in the tooth of *A. hypopotamoides*, but the damaged condition of this part in all the three specimens forbids a closer comparison. The tooth figured in the woodcut agrees in all respects with the specimen represented in plate XXIV, figure 3, except that the 'cingulum' in the former is rather less fully developed than in the latter.

The foregoing comparisons lead to the conclusion, improbable as it at first sight appears, that the two molars last described, although agreeing in size, are so different from the molar of *Anthracotherium hypopotamoides* that it seems difficult to refer them to the same species. A comparison of these two teeth with the tooth represented in plate XXIII, figure 4, will, moreover, lead to the conclusion that the three teeth belong to the same genus of animal, and as it was shown that the specimen above-mentioned could not be separated from the genus *Hypopotamus*, it will be necessary to refer, provisionally, the two larger teeth to the same genus. As no named species has teeth as large as these specimens, if the generic determination be correct, it is clear that these specimens must belong to a new species, for which the name of *H. giganteus* is proposed.

The close similarity existing between the upper molars of *Hypopotamus giganteus* and those of *Anthracotherium hypopotamoides*, and the gradual transition in respect of the character of the teeth thus effected between the two genera, seems to render it highly probable that there may be a similar transition in respect of the cranial characters, and that eventually the two genera will have to be fused together, though it has not been considered advisable to adopt this course on the evidence of the present inadequate materials. Should this course be eventually considered advisable the older name *Anthracotherium* must stand for the extended genus, and the family name *Anthracotheriidae* entirely replace the name *Hypopotamidae*, the latter course having been adopted in the present memoir. The transition from the typical form of one genus to that of the other is exhibited in the following list, which, however, does include all the species.

<i>Anthracotherium</i>	<i>magnum</i> (type)
—————	<i>alsaticum</i> .
—————	<i>silistrense</i> .
—————	<i>cuvieri</i> .
—————	<i>hypopotamoides</i> .





Owing to the imperfect condition of the specimens, further comparisons are impracticable, but the differences pointed out confirm the inferences drawn from the upper molars as to the former existence of two species of large hyopotamids in the Bhúgti hills. It is very remarkable that in one small spot (for all the remains of these forms were collected by Mr. Blanford in one day), remains of two such highly interesting, and previously totally unknown forms, should have been obtained, and it points to the great promise of these districts as a future field of research. Since, however, the Bhúgti hills are beyond the British frontier, among unruly tribes, it requires special arrangements by Government to enable any European visitor to travel through them, and it is hence unlikely that any scientific person will again visit them for a long period. The locality whence most of Mr. Blanford's specimens were obtained is known by the name of Gándri.

## GROUP B: TETRACUSPIDATI.

*Upper molars with only four columns.*

### FAMILY 2.—MERYCOPOTAMIDÆ.

*Characters.*—This family may be defined as selenodont Suina in which the upper molars have only four columns, while the mandible, as far as is known, is furnished with a large descending plate, or process, at the angle; the latter character distinguishing it from the *Oreodonfœlar*.

### GENUS I: MERYCOPOTAMUS,<sup>1</sup> Falconer and Cautley.

As this and most of the succeeding genera are each represented by only a single species, the generic characters are the same as those of the species.<sup>2</sup>

*Species.* MERYCOPOTAMUS DISSIMILIS. Falconer and Cautley.

*Synonyms.* *Hippopotamus dissimilis*. F. and C.

*Merycopotamus sivalensis*. F. and C.

*History.*—In the year 1839, Messrs. Falconer and Cautley<sup>3</sup> described the remains of a pig-like animal from the sub-Himalayan Siwaliks, under the name of *Hippopotamus dissimilis*. Subsequently it was found that the teeth differed so essentially from those of the hippopotamus that a new genus—*Merycopotamus*—was created for the reception of this form. A fine series of the remains are figured under the latter name in the "Fauna Antiqua Sivalensis,"<sup>4</sup> most of which are now in the British Museum. There is also a fine series in the Indian Museum. A notice of the osteology of this remarkable form was published by the present writer in the

<sup>1</sup> From *meris*, a ruminant, and *potamus* a river.

<sup>2</sup> A second species of *Merycopotamus* is mentioned by Dr. Falconer, but cannot be identified.

<sup>3</sup> "Paleontological Memoirs," Vol. I., pp. 130-138, *et. seq.*

<sup>4</sup> Plates LXII, LVII, and LVIII.

"Records of the Geological Survey of India" for 1876,<sup>1</sup> and a supplement to the same was published in the following year.<sup>2</sup> All the more important notices of this species previously published are recorded in those papers, and as no additional remains are described in the present memoir only a summary of its more important characters will be given.

*Characters.*—As far as can be determined from the remains known to us, *Merycopotamus dissimilis* was probably either a pente—or tetradactylate pig-like animal of about the size of the wild boar. Its dentition comprises, as far as is known, the complete placental mammalian series. The canines are relatively large, approximated to the incisors, but separated by a long 'diastema' from the premolars. The anterior premolars are sharply pointed like those of *Anthracotherium* and *Hippopotamus*: the anterior premolar is placed close to the succeeding tooth, a character in which *Merycopotamus* agrees with the pig, and differs from the hippopotamus. The upper true molars, of which there is an excellent figure in plate LXII. figure 17 of the "Fauna Antiqua Sivalensis,"<sup>3</sup> are selenodont teeth with four distinct columns, and with a well-marked 'cingulum' on their inner halves: their enamel is coarsely rugose. The external surfaces of the outer columns slope towards the centre of the crown, and their basal angles are folded over their centres, which thus become concave: a well-marked ridge occupies the median line of each of these surfaces: the loop connecting these surfaces does not project on the external surface of the crown. The crowns are remarkably low, and a rudely cruciform valley, open to the bottom, separates the four columns;—characters by which the teeth are readily distinguished from those of the true ruminants. With the exception of the absence of the fifth lobe, and the smaller development of the loop connecting the outer columns, the teeth present a striking resemblance to those of *Hippopotamus palasinicus*: the basal angles of the external surfaces of the outer columns are, however, more produced in the former. The lower molars are of the general type of those of the selenodont Suina.

The cranium presents a considerable resemblance to that of the hippopotamus, which is, perhaps most marked in the occipital region (*compare* "F. A. S.," plate LX. fig. 4c, and plate LXVIII. fig. 15): the parietal region is, however, longer and more compressed, the orbits less prominent, and the infraorbital portion longer and less expanded at its extremity. In all the points in which the skull of *Merycopotamus* differs from that of the hippopotamus, it agrees with the skulls of the *Anthracotheridae* and the true pigs. The skull is shorter than the skulls of those species of *Hippopotamus* of which the skull is known, and also differs by the presence of a distinct larvial cavity. The most striking affinity to the hippopotamus is displayed by the form of

<sup>1</sup> Vol. IX., p. 144, *et. seq.*, on page 153, line 12 from the bottom, the words *Hippopotamidae* and *Anthracotheridae* should be transposed.

<sup>2</sup> *Ibid* Vol. X., p. 34.

<sup>3</sup> A woodcut of a single molar is given in Professor Owen's memoir on *Hippopotamus*, cited above; another figure in the "Odontography" of the same author, (pl. CXL., fig. 8), and a third by Professor Gaudry, ("Les Enchaînements du Monde Animal, &c.," p. 98, fig. 124.)

the mandible (compare "*F. A. S.*," plate LXI., fig. 6a, and plate LXVII., fig. 4), as in both genera the 'angle' is produced into a large descending plate, preceded by a deep notch in the inferior border of the horizontal ramus: this plate and notch are, however, developed to a smaller extent in the *Anthracotheridæ* (plate XXIV. figure 4).

The limb-bones are nearer those of the *Anthracotheridæ* than those of the hippopotamus, as is well exemplified by the more elongated form of the astragalus (compare "*F. A. S.*," plate LXVIII., figures 9 and 20); and by the separation of the radius and ulna, and their much more elongated form. The axis vertebra, of which there is a specimen in the Indian Museum, is an elongated bone like that of *Hyopotamus*.

*Position of the genus.*—After their assignation of *Merycopotamus* to the rank of a distinct genus, the authors of the "*Fauna Antiqua Sivalensis*" still referred it to the family *Hippopotamidæ*, a reference which has been upheld by several later writers.<sup>1</sup> The intimate resemblance of the molars to those of the *Anthracotheridæ* and *Oreodontidæ* leaves, however, little doubt but that the true position of the genus is in immediate juxtaposition to those families: the form of the mandible indicates, on the other hand, a distant cousinship with the hippopotamus.

*Distribution.*—Remains of this species have hitherto been obtained only from the Siwaliks of Burma and the sub-Himalaya; the statements of their alleged occurrence in the Manchhars of Sind having been founded on bones belonging probably to allied genera.

## GENUS II: CHÆROMERYX,<sup>2</sup> Pomel.

Species: *CHÆROMERYX SILISTRENSIS*. (Pentland), *in parte*.

Synonym. *Anthracotherium silistrense*. Pentland, *in parte*.

*History and general characters.*—This genus and species is only known by the one fragment of a maxilla with three molars, obtained from the Gáro hills, and described by Mr. Pentland, in the memoir quoted above, together with other remains, under the name of *Anthracotherium silistrense*. As already stated in the notice of that species, all these remains were referred, in 1848, by M. Pomel to a new genus under the name of *Chæromeryx*, while it was subsequently shown by the present writer that this title should be confined to the one maxilla in which the molars are four-columned selenodont teeth. It has not been found possible to discover where this maxilla now is, but as a fair figure of it is given in Mr. Pentland's memoir,<sup>3</sup> and an excellent one in the "*Fauna Antiqua Sivalensis*," (plate LXVIII., figures 22 and 22a), there is no difficulty in determining its affinities. There is a cast of the specimen in the Indian Museum.

*Upper molars.*—The above mentioned maxilla, as is shown by the figures, contains three teeth, and belongs to the left side of the skull. The teeth are but slightly abraded by wear, and are, respectively, the last premolar (*left side of figure*)

<sup>1</sup> See Huxley, "*Anatomy of Vertebrated Animals*," 1st ed., p. 376.

<sup>2</sup> From *chœros*, a pig, and *méryx*.

<sup>3</sup> "*Trans. Geol. Soc.*," Ser. 2., Vol. II., pl. XLV., figs. 2 and 3.

and the first and second true molars: the first true molar is considerably smaller than the second: the largest tooth is about half-an-inch in length, and four-and-a-half tenths in width. Each of the true molars carries four distinct columns, the summits of the inner pair forming complete crescents: there is a wide 'cingulum' on the inner side. The external walls of the outer columns are more nearly perpendicular than in *Merycopotamus*, the angles of their bases less produced and the median ridges less developed. There is a more distinct loop connecting the external surfaces of these columns; but this is flattened externally, and overlaps each column.

There can be little, if any, doubt but that these teeth are generically distinct from *Merycopotamus*, though they probably belong to the same family.

These teeth also present considerable resemblance to a tooth figured by Dr. W. Kowalevsky as belonging to a form intermediate between *Hypopotamus* and *Dichodon*.<sup>1</sup> The latter tooth which has four lobes and a prominent connecting loop, has, however, a more truly ruminant structure, which is still more developed in *Dichodon*<sup>2</sup> itself.

### GENUS III: HEMIMERYX,<sup>3</sup> n. gen. nobis.

Species: HEMIMERYX BLANFORDI. n. sp.: nobis.

*History*.—Unsatisfactory as it is to form a new genus of animals merely on the evidence of a single tooth, still there are certain cases where there seems no satisfactory alternative but to adopt this proceeding; and the present and following instances are cases in point. In both of these instances a single upper molar is before us, which cannot at present be identified with the molars of any described genus, and we have accordingly either to give these teeth new generic names, or to suffer the inconvenience of here and elsewhere alluding to them, without any distinctive title or means of identification. Under these circumstances the former alternative, as being the least objectionable of the two, has been adopted.

In the "Records" for 1877,<sup>4</sup> an upper molar tooth obtained by Mr. W. T. Blanford from the lower Manchhars of Sind was briefly noticed, and considered to belong to a new genus of merycopotamid. In the following year<sup>5</sup> two other fragments of similar upper molars, and a lower molar considered as probably belonging to the same species (all obtained from the lower Manchhar rocks) were also noticed, and the generic term *Hemimeryx* was proposed for their reception. The best of the above mentioned specimens are now for the first time figured, and are designated by the foregoing generic title, with the specific name of *blanfordi*, after the discoverer of the first specimen.

*Upper molar*.—In figures 5 and 8, of plate XXIII. of this memoir, the original upper molar noticed above is represented. Figure 5 gives a view of the masticating surface, while in figure 8 the external aspect has been portrayed, but it unfortunately

<sup>1</sup> Phil. Trans. Ser. 4, pt. XXXIX, fig. 15.    <sup>2</sup> Owen, loc. cit., pt. IV., fig. 3.    <sup>3</sup> From *Hemi*, half, and *meryx*.

<sup>4</sup> Vol. X., p. 74.

<sup>5</sup> R. G. S. I., Vol. XI., pp. 74-80.

happens that the specimen has been turned upside down, so that to see the tooth in its natural position the plate must likewise be reversed. The specimen is complete with the exception of the extremities of the 'fangs,' and is a true molar (possibly the last) belonging to the left side: the tips of the columns are but slightly abraded by wear. The crown carries four crescentoid columns on the masticating surface, relatively higher than those of *Merycopotamus*. The general form of these columns is much the same in the two genera, with the important exceptions that in the postero-external column (*right upper angle of figure*) the outer surface is simply concave without any median ridge, while the corresponding surface of the antero-external column (*left upper angle of figure*) has the median ridge, though present, much more faintly developed than in *Merycopotamus*. The loop between the two external columns is much more developed than in that genus, projecting beyond the outer border of the crown. The antero-internal column (*left lower angle of figure*) is greatly developed at its anterior, and incompletely at its posterior side. As in *Merycopotamus* there is a distinct 'cingulum' on three sides of the base of the crown. The size of the tooth is about the same as that of large individuals of the latter genus; its dimensions are as follows: *viz.*—length, 1.13 inches; breadth, 1.1 inches; height, 0.81 inch.

The tooth is distinguished from the molars of *Chæromeryx* by the oblique direction of the external surfaces of the outer columns, by the incompleteness of the 'crescents' of the inner columns, and by the form of the loop connecting the outer columns. The resemblance between the tooth and the molars of *Merycopotamus* and *Chæromeryx* is, however, sufficiently strong to render it probable that it belongs to the same family. It does not appear to come as near to the molars of any other genus as to those of *Chæromeryx* and *Merycopotamus*, from which, however, it is most markedly distinct. In the points in which it differs from the latter genus it approximates to the molars of the *Anoplotheridae* and the true ruminants. It has, indeed, a very marked superficial resemblance to the upper molars of *Anoplotherium commune*, especially noticeable in the incompleteness of the crescent formed by the first inner column, which thus makes an approach to the separation of this column into two distinct portions, as is the case in *Anoplotherium*. The molar of *Hemimeryx* is, however, readily distinguished from that of *Anoplotherium* by the absence of the isolated pillar on the hinder side of the first inner column, as well as by the greater lateral curvature and obliquity of the external surfaces of the outer columns, and by the incompleteness of the horse-shoe-like connecting loop.

*Lower molar.*—In figure 1 of plate XXIII. there is represented a nearly complete left lower molar, from the lower Manchur rocks, evidently belonging to some species of selenodont pig, and from its size provisionally referred to the present species: it is the specimen alluded to on page 79 of the XIth volume of the "Records." The tooth is in a very early stage of wear, the outer columns being scarcely touched: the two hinder columns are somewhat broken. It is distinguished from the lower molars of *Merycopotamus* by the crown being lower, by the transverse valley being nearly

blocked, instead of freely open, on the inner side, and by the inner columns being flatter and less completely conical; this flatness is especially noticeable on the inner side. The specimen more nearly resembles the lower molar referred to *Hypopotamus palasiadicus* (pl. XXIII. figure 3; *this figure is viewed more from the external aspect than figure 1*), but is distinguished by the columns being much narrower and sharper, and the median valley narrower and deeper: there is also a more distinct 'cingulum' on the anterior aspect. The dimensions of the specimen are as follows:—

	In.
Length (of two columns) . . . . .	0.8
Width . . . . .	0.6
Height of antero-internal column . . . . .	0.5

*Distribution.*—No other remains have hitherto been discovered which can be referred to this species, which is thus confined to Sind. It is much to be hoped that other remains may eventually be discovered, which will further elucidate the affinities of this and the following interesting forms.

#### GENUS IV: SIVAMERYX,<sup>1</sup> n. gen. nobis.

Species: SIVAMERYX SINDIENSIS. nobis.

*Upper molar.*—In figure 11 of plate XXIII there is represented, from the masticating surface, the single upper molar on which this genus is founded, the only previous notice of which will be found on page 80 of the XIth volume of the "Records," where the name was proposed. The tooth is an almost unworn specimen from the right maxilla, and was obtained by Mr. F. Fedden from the lower Manchhars of Sind: it is quite perfect. An inspection of the figure will show that the tooth clearly belongs to the present group of animals, viz.—tetracuspidate selenodont pigs. There is, however, in the structure of the tooth an approach to the molars of the pentacuspidate group which has not been observed in any other genus; it also makes a further step in the direction of the more generalised forms of the true ruminants, than the molar of *Hemimeryx*, but still preserves the open valleys, and the complete union of the bases of the outer columns, characteristic of the selenodont pigs. On the anterior side of the specimen (*right side of figure*) the ridge leading from the inner column carries, near the transverse valley, a small triangular process (*not very clearly shown in the figure*), touched by wear before the inner column, and evidently the representative of the fifth column of the *Anthracootheridae*. The two inner columns are more developed on the side of the middle valley than in the allied genera: there is a well-marked crenulated 'cingulum' on three sides. Without further describing the tooth in detail, it will suffice to point out in what respects, in addition to the presence of the rudimentary fifth column, it differs from the molars of the allied genera. The tooth, except in the absence of the fifth column, presents some resemblance to the molars of *Hypopotamus crispus*,<sup>2</sup> and may have belonged to

<sup>1</sup> From *Siva* (or properly *Shiva*) the Hindu deity whose name forms the root of the word Sivallia (Sivallia), and *meryx*.

<sup>2</sup> Cuvier, "Zoologie et Paléontologie Françaises," 2nd ed., pla. XXII., fig. 7; XXXII., fig. 9.

an animal connecting that somewhat abnormal form with the tetracuspitate selenodont Suina: it is, however, distinguished by the form of the external surfaces of the outer columns. Irrespective of its considerably smaller dimensions, the tooth differs from the upper molar of *Hemimeryx* (plate XXIII, figure 5), by the much greater development of the vertical ridges on the external surfaces of the outer columns; by which means the external surface of the second outer column (*left-hand top corner of figure 11*) has its middle line as high as its right side, whereas in *Hemimeryx* the corresponding surface (*right-hand top corner of figure 5*) is most markedly concave. The antero-internal lobe is, moreover, considerably more complex than in *Hemimeryx*.

From the molars of *Merycopotamus*, the tooth before us differs very widely, not only in size, but also in structure. The outer columns have their external surfaces placed less obliquely to the vertical axis of the crown, and their lateral borders are not so much produced above the middle line. The loop connecting the outer columns is relatively larger and more compressed laterally: the external surfaces of the outer columns are wider, and so-to-speak, less squeezed together.

The tooth is larger than the molars of *Charomeryx* and differs by having the valleys wider and more open, by the more compressed form, and less outward development of the loop connecting the outer columns, and also by the form of the external surfaces of the outer columns, as can be seen by a comparison of the figures. The specimen makes some approach to the molars of *Dicrocerus*,<sup>1</sup> but is distinguished by the incompleteness of the inner 'crescents,' by the outward extension of the transverse valley, and by the longitudinal valley being quite open.

The tooth before us does not seem to approach to any other described form, and it seems, therefore, necessary to refer it provisionally to a new genus, for which the above title, with the specific name of *sindensis* may be adopted.

*Other remains.*—As is mentioned in the "Records,"<sup>2</sup> Mr. Feilden has also obtained a lower molar, and the hinder portion of a cranium of a small animal allied to *Merycopotamus*, which may not improbably belong to the present species: both specimens came from the lower Mandibulars of Sind. The tooth is of much the same form as the specimen represented in plate XXIII, figure 1, but is of smaller size: it does not present any characters of generic value, and, therefore, is not figured. The portion of the cranium comprises only the cerebral box, and as it has been much rolled and otherwise damaged, it has not been figured. It agrees in relative size with the upper molar, and as far as can be determined, presents a general resemblance to the skull of *Merycopotamus*; the cerebral box is, however, more compressed laterally. Further comparisons are impossible owing to the imperfect condition of the specimen.

<sup>1</sup> "Les Enchaînements du Monde Animal, etc.," p. 97, fig. 120.

<sup>2</sup> Vol. XI, pl. 80.



FAMILY 3.—*OREODONTIDÆ*.

*Character.*—This family, taken here as comprehending the genera *Oreodon*, *Eporodon*, *Agriocherus* and *Merycocherus*, is distinguished from the last by the mandible lacking the characteristic descending plate at the 'angle,' and by the nearer approach in the plan of structure of the molars to the true ruminants. The family has hitherto been recorded only from the tertiary of north America, but the molar tooth described below would seem to indicate that it formerly existed in north-western India. It will be remembered that in the previous volume of this work,<sup>1</sup> it was pointed out that the lower molars of the extinct Siwalik camel present a remarkable affinity to those of the American cameloid *Auchenia*, and since the oreodons are considered to be intimately connected with the tertiary ancestors (*Procamelus*, etc.,) of the modern camels, it is a fact of much interest to find that the Siwalik camel lived in a country which had also a representative of the oreodons and agriocheres.

GENUS *AGRIOCHERUS*,<sup>2</sup> Leidy.

As the reference of the molar described below to this genus is merely provisional, the generic characters are not given. The genus is stated to have relationship with *Hypopotamus*.

*Species, non. det.*

*Upper molar.*—The specimen provisionally referred to the above genus is an, unfortunately incomplete, upper molar: it is represented from the masticating surface in figure 2, of plate XXIII, and will be seen to belong to the left side of the cranium. This tooth has been scarcely affected by wear, but has lost a part of its postero-internal column, as well as the external walls of both the outer columns. It was collected in 1878, by Mr. F. Fedden, in the lower Mandihars of the Laki Hills of Sind.

The crown carries only four columns without the slightest trace of the fifth accessory column. The inner columns are stout and low: rounded and conical on their inner, and regularly crescentic on their outer sides: they are more symmetrical than those of any of the previously described genera. The median longitudinal valley is deeper and more distinct than in the preceding genera, whereby the outer columns are more widely separated from the inner, and are not thrust within their crescents. The two outer columns are closely approximated at their bases, so that there could not have been a wide transverse valley terminating externally in a projecting loop. The external surfaces of the outer columns were probably nearly vertical, and not produced at their angles, as in the preceding genera. There is a

<sup>1</sup> p. 61.<sup>2</sup> From, *agris*, wild, and *cheira*, a pig. This genus is generally, as here, classed with the *Oreodontida* (see Nicholson's "Palaeontology," 2nd ed., p. 352), but Professor Leidy is inclined to refer it to a distinct family, (see "Contributions to Extinct Vertebrate Fauna of Western Territories," p. 216.)

well-defined 'cingulum' on the internal surface of the one complete inner column which now remains. The length of the specimen is 0.58 inch, and the height of its outer column 0.34 inch.

*Comparisons.*—There can be no question as to the generic distinctness of the tooth under consideration from the molars of the other Siwalik selenodont pig-like animals; neither can it be identified with those of any European representative of the same group. Turning, however, to the American *Oreodontidae*, the tooth will be found to resemble very closely in general structure the molars of the genera *Oreodon*,<sup>1</sup> *Epooreodon*, *Agriochærus*, and *Merychochærus*.<sup>2</sup> A comparison of the specimen with the admirable figures of the molars of these genera given by the transatlantic palæontologists, as well as with actual specimens and casts in the British Museum, has shown that the resemblance is so close that there seems no doubt but that the Indian specimen should be referred to some member of the same family. The molars of *Oreodon* (*Epooreodon*) *major* seem, except in the matter of size, to come very close to the Indian tooth: the form of the 'cingulum' and inner columns being strikingly similar in both. In the matter of size, the Indian specimen comes nearer to the molars of *O. culbertsoni*,<sup>3</sup> but in those teeth the valleys are less completely open. The nearest approach to the Indian tooth seems, however, to be made by the teeth of *Agriochærus latifrons*. If the figure given in this memoir be compared with the very excellent woodcut of an upper molar of the latter species, given (after Professor Leidy) by Professor Gaudry, on page 98 of the oft-quoted "Enchaînements du Monde Animal," it will be seen that (as far as the imperfect condition of the Indian tooth will permit of comparison,) there is an almost, if not complete, identity between the two specimens, and they might very readily be taken for the teeth of the same species. The absence of the external surface of the Indian tooth renders it uncertain whether the form of this part would be precisely the same as the American tooth, and as there appears to be some difficulty in always distinguishing isolated teeth of *Agriochærus*, *Oreodon* and *Merychochærus*, it would not be safe to identify the Indian tooth with *A. latifrons*, though it would be unwise to say that it might not belong to that species. It seems, however, certain, as already said, that the tooth belongs to the *Oreodontidae*, and it is accordingly provisionally referred to the genus *Agriochærus*, with the possibility of its belonging to the American species *A. latifrons*. With this possibility in view no specific name is assigned to the Indian tooth, and it must also be borne in mind that there is a further possibility that the generic determination may eventually be proved incorrect, though this is improbable.

<sup>1</sup> *Proc. Acad. Nat. Sci. Phila.* 7 to 19.

<sup>2</sup> *Ibid.* figs. 1 to 5.

<sup>3</sup> *Ibid.* fig. 12.

## SECTION : RUMINANTIA.

## ? FAMILY.—PALÆOMERYCIDÆ.

GENUS : PROPALÆOMERYX n. gen. *nobis*.

As this provisional genus is founded on a single molar, its characters may be gathered from the following description of that specimen.

Species : PROPALÆOMERYX SIWALENSIS, *nobis*.

*Upper molar*.—In a paper by the writer, styled a "Sketch of the History of the Fossil Vertebrata of India," it is stated that "a single molar in the Indian Museum seems to indicate a Siwalik representative of the genus *Palæomeryx*." The specimen on which this statement rests is figured in the accompanying woodcut : it cannot be said that it properly belongs to the subject of the present fasciculus, but it does not come very inappropriately after the more ruminant-like *Suina*, and as it has some connection with teeth described in the preceding fasciculus, it has been found convenient not to postpone its description. The specimen<sup>1</sup> is from the sub-Himalayan Siwaliks, and was formerly in the Rürki Museum, whence it was transferred by exchange to the Indian Museum.



Fig. 2. *Propalæomeryx siwalensis*, left upper true molar—Siwaliks—near Rürki.

The specimen is a perfect upper molar of the left side, in an intermediate stage of detrition. The figure will at once show that it belongs to a member of the true ruminant section, although the lowness of the crown, and the width and shallowness of the central 'pits' indicate that it belongs to one of the primitive and little specialised members of that section. The structure of the enamel, which is faintly rugose, and the oblique position of the external walls of the 'lobes,' indicate affinity with the *Camelopardalids*, *Cervids*, and their allies.

The 'crescents' are separated far down into the crown, and the first of these (*left side of figure*) is unsymmetrical, being produced on its anterior side. The external walls of the 'lobes' are set more nearly in the same line than in *Camelopardalis* (plate XVI of preceding part, figs. 1 and 2), which character, together with the finer structure of the enamel, and the imperfect 'cingulum' which is seen on the anterior 'crescent,' distinguishes the tooth from the molars of the last named genus. There is no trace of any tubercle at the entrance to the median transverse valley. There is a distinct 'costa' on the outer surface of the anterior 'lobe,' but none can be detected on the posterior 'lobe.'

The tooth, as already said, certainly does not belong to *Camelopardalis*, neither does it belong to *Orasius* of Wagner. The crown seems too low and the central 'pits' too shallow for it to have belonged to any of the true *Cervids*.

On the whole the specimen appears to come nearest to the upper molars of *Palæomeryx bojani*<sup>2</sup> of the European miocene. There are no specimens of the molars

<sup>1</sup> J. A. S. B., Vol. XLIX, pl. 2, p. 28.

<sup>2</sup> No. B. 337, Ind. Mus.

<sup>3</sup> H. von Meyer, "Fossile Zähne von Georgensmünd," 1834, pl. IX., fig. 75; pl. X., fig. 79.

of this form in the British Museum, but by the courtesy of Professor Gaudry an opportunity has been afforded of comparing the Indian tooth with a specimen of the upper molar series of that species from Sansan, in the Paris Museum (No. 5954). The Sansan teeth are much less worn than the Indian tooth, but allowing for this difference, there is a very close general resemblance between the two specimens. The Sansan teeth are, however, distinguished by having the 'costæ' on their external surfaces, more prominently developed, by the presence of a distinct 'cingulum,' and a large tubercle at the entrance of the median transverse valley. The central pits seem rather wider and shallower. In the structure of the enamel, and in size, the specimens are very similar.

Another European species, *P. emiensis*,<sup>1</sup> from the miocene of Eningen, is of nearly the same size as the Indian tooth, but is apparently only known by the mandible.

There can be no question that the Indian tooth is not specifically the same as *Palæomeryx bojani*; and, taking into consideration the small differences in the molar teeth of ruminants which are of generic value, it seems highly probable that it should be referred to another genus. Its general resemblance to *Palæomeryx* is, however, so great that it almost certainly belongs to some closely allied form, and as it cannot be identified with any other known genus, the provisional generic name of *Propalæomeryx* is proposed for its reception, with the specific affix of *siwalensis*.

*Lower molar?*—It is just possible that the last lower molar represented in figure 6 of plate XVI of this volume, and referred to *Camelopardalis siwalensis*, together with a similar specimen described in the text, may belong to the present species, the resemblance of the Indian upper molar and the upper molars of *Palæomeryx bojani* to those of *Camelopardalis* being so great, that it is very probable there might be considerable difficulty in always separating the lower molars of these forms.

Judging from the teeth alone, it is probable that the larger species of *Palæomeryx* and the new genus *Propalæomeryx* were close links between *Camelopardalis* and the true *Cervidae*. If the 'costæ' of the molars of *Palæomeryx bojani* were slightly less developed, the 'cingulum' and tubercles suppressed, the 'pits' a little deeper, and the enamel a little more rugose, it would be very difficult to distinguish them from those of *Camelopardalis*.

<sup>1</sup> Meyer, "Palæontographica," Vol. II, p. 78, pl. XIII, fig. 5.

175—34 INDIAN TERTIARY AND POST-TERTIARY VERTEBRATA.

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(In these memoirs references are given to the earlier memoirs on the genus.)

#### ADDENDUM.

From the miocene of Switzerland are named two little known species of *Anthracotherium*, viz. *A. valdensc*, Kow., and *A. lukarpi*, Renev.: they are probably synonyms of the species given in the list on pages 7-8.<sup>1</sup>

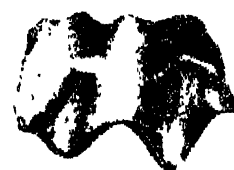
<sup>1</sup> See O. Heer, "Die Urwelt der Schweiz," 2nd ed., p. 713.

## PLATE XXIII.

- Fig. 1. *HEMIMERYS BLANFORDI* (?) Lydekker. Left lower true molar, in an early stage of wear, viewed from the grinding surface. (No. B. 90, Ind. Mus.)
- „ 2. *AGRIOTHERIUM* (?) sp. Left upper true molar, scarcely touched by wear, viewed from the grinding and inner aspects. (No. B. 94, Ind. Mus.)
- „ 3. *HYOPOTAMUS PALFINIENSIS* (?) Lydekker. Third left lower true molar, wanting the third column, in an intermediate stage of wear, viewed from the grinding and inner aspects. (No. B. 84 Ind. Mus.)
- „ 4. *HYOPOTAMUS PALFINIENSIS*, Lydekker. Right upper true molar, in a very early stage of wear, viewed from the grinding surface. (No. B. 83, Ind. Mus.)
- „ 5. *HEMIMERYS BLANFORDI*, Lydekker. Left upper true molar, in a very early stage of wear, viewed from the grinding surface. (No. B. 89, Ind. Mus.)
- „ 6. *HYOPOTAMUS PALFINIENSIS*, Lydekker. Left upper true molar, in an intermediate stage of wear, viewed from the grinding surface. (No. B. 82, Ind. Mus.)
- „ 7. External aspect of fig. 4.
- „ 8. External aspect of fig. 5: the figure is reversed, the points of the lobes should have been directed downwards as in fig. 7.
- „ 9. External aspect of fig. 6.
- „ 10. *ANTHRACOTHERIUM SILISTRENSIS*, Pentland. Third right upper true molar, in an early stage of wear, viewed from the grinding surface. (No. B. 103, Ind. Mus.)
- „ 11. *SIVAMERYS SINIHENSIS*, Lydekker. Right upper true molar, scarcely touched by wear, viewed from the grinding surface. (No. B. 91, Ind. Mus.)
- „ 12. *ANTHRACOTHERIUM SILISTRENSIS*, Pentland. Second right upper true molar, scarcely touched by wear, viewed from the grinding surface. (No. B. 103, Ind. Mus.)

All the specimens were collected by Messrs W. T. Blanford, and F. Feilden in the lower Manchhars (Siwaliks) of Sind, and are represented of the natural size.

[The heading of the plate should be "Tertiary Vertebrata" in place of "Tertiary Mammalia."].





## PLATE XXIV.

- Fig. 1. 1a. *ANTHRACOTHERIUM SILISTRENSE*, Penland. Part of the right ramus of the mandible, showing the three true molars, in an early stage of wear. Collected by Mr. Theobald in the Siwaliks of the Punjab. (No. B. 106, Ind. Mus.), fig. 1, viewed from the grinding surface; 1a. from the outer side.
- „ 2. *ANTHRACOTHERIUM HYOPOTAMOIDES*, Lydekker. Part of the right maxilla showing the third true molar, and the base of the second. Collected by Mr. W. T. Blandford in the lower Manchhars (Siwaliks) of the Bhūgti hills, north of Sind. (No. B. 426, Ind. Mus.) The specimen is viewed from the grinding surface, and the one remaining tooth is but slightly touched by wear.
- „ 3. *HYOPOTAMUS GIANTENS*, Lydekker. The third upper true molar of the left side, in an intermediate stage of wear, and viewed from the grinding surface. (No. B. 427, Ind. Mus.); same history as last specimen.
- „ 4. *HYOPOTAMUS PALÆINDICUS* ?, Lydekker. Part of the left ramus of the mandible, showing the bases of the second and third true molars. Collected by Mr. Fodden in the lower Manchhars of Sind, and viewed from the outer side. (No. B. 85, Ind. Mus.)

All the specimens are represented of the natural size.



## PLATE XXV.

- Fig. 1. *ANTHRACOTHERIUM HYOPOTAMOIDES* (?) Lydekker. Fragment of the hinder extremity of the right ramus of the mandible, showing a part of the last true molar. (No. B. 430, Ind. Mus.)
- .. 2. *HYOPOTAMUS GIGANTEUS* (?) Lydekker. Portion of the hinder extremity of the right ramus of the mandible, showing the last true molar. (No. B. 428, Ind. Mus.)
- .. 3. *ANTHRACOTHERIUM HYOPOTAMOIDES* (?) Lydekker. Fragment of the middle portion of the right ramus of the mandible, showing a part of the first, and the whole of the second true molar. (No. B. 429, Ind. Mus.)

All the specimens were collected by Mr. W. T. Blanford, from the lower Manchar rocks of the Bhigti hills, to the north of the Sind frontier, and are represented of the natural size. Fig. 2 is viewed from the outer aspect; while figures 1 and 3 are viewed obliquely from both the upper and outer aspects.

[The heading of the plate should be "Tertiary Vertebrata," in place of "Tertiary Mammalia."]

